

## **REMARKS**

In the Action, claims 1-3, 5, 6 and 8-13 are rejected. In response, new claims 14 and 15 are added to depend from claims 1 and 5, respectively. The pending claims in this application are claims 1-3, 5, 6 and 8-15, with claim 1 being the sole independent claim.

Claim 14 recites the distillate from the distillation being recovered and stored once in an intermediate tank and then supplied to the reactor as disclosed on page 12, line 16 to page 13, line 5, and page 15, line 17 to page 16, line 18 of the specification. Claim 15 recites that the concentration of the hydroxyalkyl (meth)acrylate can be lowered in the distillate as disclosed on page 13, lines 9-10 of the specification.

In view of the following comments, reconsideration and allowance are requested.

### **Rejection Under 35 U.S.C. § 103(a)**

Claims 1-3, 5, 6 and 8-13 are rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 3,709,928 to Murayama et al. in view of U.S. Patent No. 4,317,926 to Sato et al., and further in view of the section in the *Kirk-Othmer Encyclopedia of Chemical Technology* relating to (meth)acrylic acid. Murayama et al. is cited for disclosing a process for producing hydroxyalkylacrylates and distilling the reaction mixture where the resulting distillate contains (meth)acrylic acid. Sato et al. is cited for disclosing the use of polymerization inhibitors, and *Kirk-Othmer* is cited for disclosing that (meth)acrylic acid is an industrially important chemical. The Action contends that it would be obvious to recover (meth)acrylic acid by distillation and to recycle the (meth)acrylic acid to the reaction mixture.

The combination of the cited patents do not disclose or suggest the claimed invention since the cited patents do not disclose recovering (meth)acrylic acid by distillation and thereafter recycling the recovered (meth)acrylic acid. Murayama et al. relates only to a

process for producing hydroxyalkyl (meth)acrylates by the reaction of alkylene oxides and (meth)acrylic acid. As noted in the Action, Murayama et al. only discloses distilling the resulting reaction mixture to recover a purified hydroxyalkyl (meth)acrylate. Murayama et al. provides no suggestion of recovering the (meth)acrylic acid, and thereafter recycling the recovered (meth)acrylic acid.

The Action refers to Table 1 as allegedly supporting the position that Murayama et al. recovers the (meth)acrylic acid. However, Table 1 of Murayama et al. is provided to show the effects of the addition of the glycol to the distillation, and particularly the reduced amount of ethylene dimethacrylate. As disclosed in column 5, lines 33-36 of Murayama et al., the effects of the addition of the polyalkyleneglycols result in a process that "is markedly high in value as a commercial scale purification process". Thus, it is clear that Murayama et al. is concerned with purifying the resulting hydroxyalkyl (meth)acrylate and minimizing the amount of impurities and byproducts in the distillate. Murayama et al. is not concerned with recovering unreacted (meth)acrylic acid. The distillation step of Murayama et al. is tailored to maximize the amount of the hydroxyalkylacrylate while minimizing the amount of impurities and byproducts and particularly the ethylene dimethacrylate.

Table 1 of Murayama et al. discloses the distillate containing 0.4 wt% (meth)acrylic acid and 98% hydroxyethyl (meth)acrylate. Murayama et al. provides no suggestion of recovering the (meth)acrylic acid from the hydroxyethyl (meth)acrylate and thereafter recycling the (meth)acrylic acid. Furthermore, the resulting distillate contains 0.4 wt% (meth)acrylic acid and 1.6 wt% of other impurities or byproducts. Thus, even if Murayama et al. were to isolate the hydroxyethyl (meth)acrylate from the remaining 2% of the distillate, it would not have been obvious to one of ordinary skill in the art to further isolate such a small amount of (meth)acrylic acid and recycle the (meth)acrylic to the reaction mixture.

The process of Murayama et al. is similar to the prior processes that the present invention seeks to improve upon. As in all the prior patents cited during the examination of this application, Murayama et al. does not disclose or suggest distilling the reaction mixture to recover unreacted (meth)acrylic acid. The cited patents including Murayama et al. only disclose distilling the reaction mixture to recover a purified hydroxyalkyl (meth)acrylate. Furthermore, the cited patents including Murayama et al. fail to disclose recycling (meth)acrylic acid obtained by distillation.

Murayama et al. is specifically directed to a process of adding an alkylene glycol to the reaction product to prevent the formation of diesters and other insoluble products that adhere to the heating portion of the distillation column. As noted in column 2, lines 25-49 of Murayama et al., the insoluble solids adhere to the distillation apparatus which requires an increase in heat to enable the distillation of the hydroxyalkyl (meth)acrylates. The increase in heating causes the formation of the diesters which distill out with the hydroxyalkyl (meth)acrylates. Murayama et al. is specifically directed to reducing the formation of the diesters, thereby improving the yield of the hydroxyalkyl (meth)acrylates. Murayama et al. is not concerned with recovering and recycling (meth)acrylic acid from the reaction mixture.

The Action is incorrect in stating that the only difference between Murayama et al. and the claimed invention is the failure to disclose recycling the (meth)acrylic acid. The Action refers generally to Table 1 for the position that the distilled product contains unreacted (meth)acrylic acid. As noted above, Table 1 only discloses that the recovered hydroxyalkyl (meth)acrylates contain very small amounts of unreacted (meth)acrylic acid and diesters. The distillation process of Murayama et al. is specifically carried out to recover the hydroxyalkyl (meth)acrylates and not to recover (meth)acrylic acid. The passages referred to in the Action do not support the position that it would have been obvious to recycle the distilled product. It

would not have been obvious to recycle a distilled reaction product of Murayama et al. that contains only 0.4 wt% (meth)acrylic acid.

In view of the deficiencies of Murayama et al., the claimed invention would not have been obvious to one of ordinary skill in the art. The art of record provides no suggestion of recovering (meth)acrylic acid by distillation and thereafter recycling the recovered (meth)acrylic acid. The claims depending from claim 1 are also allowable over the art of record. Murayama et al. provides no suggestion of recovering unreacted alkylene oxide with the unreacted (meth)acrylic acid by the distillation step and thereafter recycling the reactants as recited in claim 2. Murayama et al. further fails to suggest separating unreacted alkylene oxide from the reaction liquid prior to distilling where the distillation is to recover unreacted (meth)acrylic acid as recited in claim 3. Murayama et al. also fails to disclose or suggestion the distillation plate column of claim 5, purifying the resultant reaction liquid containing the crude hydroxyalkyl (meth)acrylate after recovering the unreacted (meth)acrylic acid by distillation as in claim 8, purifying the reaction liquid by a second distillation step as in claim 9, continuously recycling the unreacted (meth)acrylic acid as in claim 10, transferring the distillate to a reaction apparatus in claims 11, 12 and 13, either alone or in combination with the process steps of claim 1.

The art of record does not disclose or suggest the plate column or packed column of claim 5 or where the concentration of the hydroxyalkyl (meth)acrylate can be lowered in the distillate as in claim 15. The effect of the plate column and/or packaged column compared with a flash distillation apparatus is disclosed at page 13, line 6 to page 14, line 6 of the specification. The specification discloses the importance of the feature of claim 5 when the unreacted (meth)acrylic acid is recovered. The art of record does not disclose the recovery of

unreacted (meth)acrylic acid. Thus, the art of record also does not disclose the detailed condition for the distillation of recovering the unreacted (meth)acrylic acid).

Thus, it is evident from the description of page 13, line 6 to page 14, line 6 of the specification that the features of storing the distillate and the lowering of the concentration of the hydroxyalkyl (meth)acrylate in the distillate of claim 14 and claim 15, respectively, are important. Especially, the amount of the distillate is comparatively decreased because a plate column and/or a packed column are used. In addition, the concentration of the hydroxyalkyl (meth)acrylate is comparatively lowered in the distillate. Therefore, the reaction yield is decreased only a small amount when this distillate is recycled in the reaction. In addition, it is favorable that the volume of the reaction apparatus is comparatively diminished.

If the concentration of the hydroxyalkyl (meth)acrylate is raised, the concentration of the raw materials are lowered, and thus, the reaction rate is decreased. Therefore, the formation of the diester or dialkylene glycol mono(meth)acrylate is increased, and the reaction yield of the hydroxyalkyl (meth)acrylate is decreased. Further, the reaction time is prolonged because the reaction rate is decreased, which results in comparatively enlarging the volume of the reaction apparatus. Please see page 13, line 14 to page 14, line 6 of the specification.

On the other hand, the prior art does not suggest the above-mentioned problems when recovering and recycling the unreacted (meth)acrylic acid. The prior art does not suggest that a plate column and/or a packed column are especially favorable or how to attain the results of the present invention.

Sato et al. is cited in the Action for disclosing a process of using polymerization inhibitors. However, Sato et al. is not directed to a process for producing hydroxyalkyl (meth)acrylates and thereafter recovering (meth)acrylic acid. Instead, Sato et al. is directed to

a process of producing acrylic acid by a catalytic vapor phase oxidation. The passage referred to in the Action discloses the use of polymerization inhibitors in the reaction for producing the acrylic acid. Sato et al. has no relation to a process of producing hydroxyalkyl (meth)acrylates or recovering (meth)acrylic acid by distillation.

Furthermore, Sato provides no suggestion of the claimed polymerization inhibitors for use in a distillation of a reaction product to recover (meth)acrylic acid. In particular, Sato et al. provides no suggestion of the combination of an N-oxyl compound and at least one compound selected from the group consisting of phenol compounds, paraphenylenediamines, amine compounds, copper dialkydithiocarbamates and nitroso compounds as recited in claim 6. The passage referred to in the Action does not disclose or suggest the combination or joint use of the polymerization inhibitors as claimed. Furthermore, as noted above, Sato et al. relates to the production of acrylic acid. Thus, it would not have been obvious to one of ordinary skill in the art to use the claimed combination of polymerization inhibitors in the claimed distillation process.

*Kirk-Othmer* is cited for disclosing that (meth)acrylic acid are important commercial products. Applicants do not dispute that (meth)acrylic acid are industrially important compounds. However, the passages in *Kirk-Othmer* provide no suggestion of recycling (meth)acrylic acid. More importantly, *Kirk-Othmer* provides no suggestion to distill a reaction product to recover the (meth)acrylic acid, and thereafter recycling the recovered (meth)acrylic acid. Therefore, one skilled in the art would not be motivated to modify the process of Murayama et al. according to *Kirk-Othmer* as suggested in the Action.

The Action contends that the Declaration is defective since the Declaration does not expressly claim priority to the priority document. This does not render the Declaration defective. Furthermore, a Declaration is not required to expressly claim priority. The claim

for priority was filed as a separate paper with the original filing of the application. A certified copy of the priority document was also submitted to perfect the claim for priority. However, as suggested in the Action, an application data sheet is attached herewith.

In view of the above comments, the claims are submitted to be allowable over the art of record. Reconsideration and allowance are requested.

Respectfully submitted,



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